"You can't deal with such thinking by applying logic. So, we changed our procedure. We would fire the shells in the morning and spend the afternoon finding the duds, to which we attached kerosene lanterns. At dusk, a fighter-bomber would fly over the area and bomb the lanterns—and the duds—to a molecular state. It was neat and it worked."

Styles of Thinking

Research is based on reasoning. Good researchers and good managers alike practice habits of thought that reflect sound reasoning—finding correct premises, testing the connections between their facts and assumptions, making claims based on adequate evidence. Drawing supportable generalizations from limited data is the product of extending the inference process to statistical testing.

Like all specialties, research has its own terminology. To communicate our meanings with precision within a community of research users and research practitioners, who demand consistency of definitions for shared meaning, it is necessary to learn the specialized terminology of research.

At the heart of every research course is the question of perspective. Different fields of business research make different assumptions about reality and the nature of data. How one sees the world affects the kind of questions asked and what can be accepted as explanations. Reserve army captain and journalist Wines asked different questions than did the army brass. Myra asked, "What causes an inert, 'dud' bomb to explode hours after deployment?" The army asked, "What speed of impact would cause the 'dud' bomb to explode?" Of the hundreds of questions about organizations or finance or marketing that can be asked, each presupposes a "normative perspective" for that particular question. Some questions will be more productive than others for obtaining answers, especially those where the questioner correctly assumes the perspective of the respondent.

Due to selective perception and conditioning, people analyze problems differently. In this chapter, scientific inquiry, the preferred method for analyzing problems for researchers, is contrasted with other styles of thinking—induction and deduction. Both of these latter styles are necessary for reasoning throughout the research process. Also explored is the role of the scientific attitude in energizing the conduct of research. Finally, we describe how science terminology has become the specialized language of research. In that section, the building blocks for constructing theory and designing research studies are defined and explained.

Sources of Knowledge

We offer insights on evaluating external secondary data sources in Chapter 10.

Sources of knowledge range from untested opinion to highly systematic styles of thinking. As we go about our daily lives, we rarely think about how we "know" something or where this knowledge originated. From ancient times to the present, researchers have pursued the discovery of *how* we know. In the process of this discovery, researchers depend on an ability to discriminate among information sources. Researchers must, therefore, identify those sources of high quality and high value that will produce the best results for a given situation or decision facing management.

The philosophy of science provides classifications that help us with this task. Thinking styles associated with the scientific method are generally regarded as the preeminent means for securing truth, although that "truth" may not be permanent or enduring. But scientific method is not the only source of our knowledge, as this section explains.

EXHIBIT 2–1 Styles of Thinking

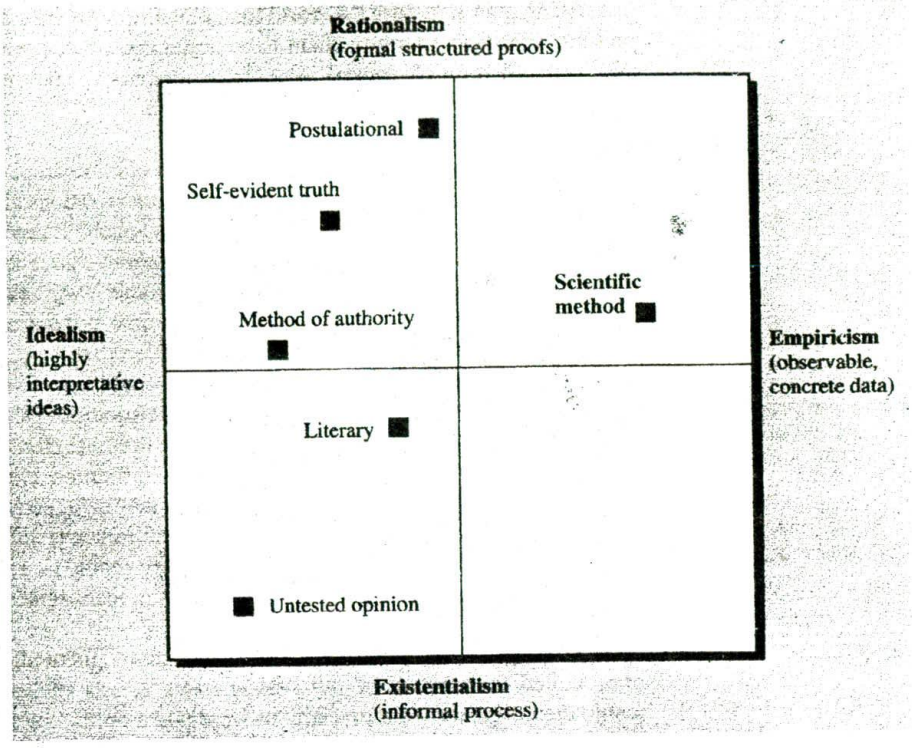


Exhibit 2–1 classifies six of the styles of thinking and locates them from the standpoint of logic.[1]

- Untested opinion
- Self-evident truth
- Method of authority
- Literary
- Scientific method
- Postulational

The axes, with end points of empiricism and rationalism, orient us. The horizontal axis ranges from a highly idealistic interpretation on one end to empiricism on the other. **Empiricism** is said "to denote observations and propositions based on sensory experience and/or derived from such experience by methods of inductive logic, including mathematics and statistics."[2] Empiricists attempt to describe, explain, and make predictions by relying on information gained through observation. This book is fundamentally concerned with empiricism—with the design of procedures to collect factual information about hypothesized relationships that can be used to decide if a particular understanding of a problem and its possible solution are correct.

In Exhibit 2–1, the vertical axis is used to represent knowledge obtained through inductive, empirical approaches or through theoretical means that are based in deductive reasoning. At one end of the vertical axis is **rationalism,** where reasoning or applying judgment is a primary source of knowledge. Rationalism differs from empiricism in that rationalists believe all knowledge can be deduced from known laws or

basic truths of nature (for example, gravity). This is claimed to be possible because underlying laws structure the world logically. From the time of Sir Francis Bacon to the present, adherents of rationalism have maintained that problems are best understood and resolved through formal logic or mathematics. Such efforts, of course, operate independently of observation and data collection.

Untested Opinion People cling to untested opinion despite contrary evidence. In the indoctrination programs of less enlightened organizations, it is not unusual for new employees to hear, "That's the way we've always done it here"—a remark that confuses entrenchment and habit with efficiency. Most families have an aging relative who holds steadfastly to a conspiracy theory for a memorable world event despite overwhelming contrary evidence. The illogical conclusions of *untested opinion* are captured by Myra's experience with the locals on the firing range. Even in the face of repeated deaths of family members or friends, the locals believed they could retrieve salvageable materials from hypothetically inert bombs. Historically, myth, superstition, and hunch have been serious competitors for scientific thinking. One writer notes that before an event occurs—an event that one is trying to predict or control—myth, superstition, and hunch offer "the reassuring feel of certainty,"[3] though seldom does that feeling of certainty persist after the event is over. Managers will find little to improve their understanding of reality from untested opinion, even though human nature indicates they should be prepared to cope with its use by contemporaries when searching for solutions to management dilemmas.

Self-Evident Truth The sheriff in the opening vignette illustrates a way of knowing often called the method of *self-evident truth.* It was self-evident to him that people would die no matter what precautions were taken on the arsenal firing range. If citizens didn't die there, then they would die as a result of something else. Death is inevitable; it can be deduced from known laws of nature. But what about propositions that appear reasonable to one person or even to many at any one time but are not true? For example, "Everyone drives on the right side of the road." This "truth" is self-evident only to some of the world's drivers. Other propositions once considered reasonable include: "Women make inferior managers"; "Men of noble birth are natural leaders"; and "Japanese quality practices are universally applicable to U.S. productivity problems." We now dismiss these once self-evident propositions.



These young men are future aeronautical engineers with Boeing. Apply deductive and inductive reasoning to this image and develop your own conclusions concerning what will happen when they send their paper airplanes flying.

Method of Authority Since not all propositions or assumptions are self-evident, we rely on persons of authority to improve our confidence in our knowledge. Authorities serve as important sources of knowledge but should be judged by integrity, the quality of the evidence they present, and their willingness to present an open and balanced case. Too often authority may depend on status or position rather than on true expertise. Such celebrity authorities, when acting outside their area of expertise, are often wrong. You would be wise to cautiously accept the views of such sources. Even authorities who do meet the standards of integrity, quality evidence, and balance may find their knowledge misapplied: The perennial best-seller by Stephen R. Covey, *The 7 Habits of Highly Successful People,* justly positions Covey as an "authority" on what makes some people succeed where others fail. But when the much-anticipated merger between Hyrum Smith's FranklinQuest (the time management empire) and Covey International didn't execute the assumptions underpinning the seven habits, Covey and Smith were soundly criticized for not being exceptional managers.[4] Recognizing principles of leadership and managing a merger take highly different skills. Although the merger may have Smith and Covey totally out of their comfort zone, this doesn't make the seven habits assumptions untrue or diminish the stature of these men in their respective authority arenas.

Literary Style This problem-solving approach occupies a viewpoint toward the center of Exhibit 2–1. The literary style of thinking is used in many classic case studies in the social sciences. Case studies play a prominent role in the development of business knowledge; our nation's best graduate business programs use case studies extensively. Portions of anthropology, psychiatry, and clinical sociology also trace their roots to this origin. Abraham Maslow's theory of motivation is one example from psychology that is well known in business. The literary perspective is one where "a person, a movement, or a whole culture is interpreted, but largely in terms of the specific purposes and perspectives of the actors, rather than in terms of the abstract and general categories of the scientist's own explanatory scheme."[5] Because it is difficult to generalize from individual case studies, the literary style of thought restricts our ability to derive generally applicable knowledge or truths.

Scientific Method Exhibit 2–1 positions the scientific method close to the empirical end of the horizontal axis. The essential tenets of science are:

- Direct observation of phenomena.
- Clearly defined variables, methods, and procedures.
- Empirically testable hypotheses.
- The ability to rule out rival hypotheses.
- Statistical rather than linguistic justification of conclusions.
- The self-correcting process.

The York College example in Chapter 1 illustrates business research that uses the scientific method.

One author notes, "Current scientific methods wed the best aspects of the logic of the rational approach with the observational aspects of the empirical orientation into a cohesive, systematic perspective."[6] The application of previously tested and verifiable procedures—the ability to detonate dud bombs with active bombs dropped from fighter planes—solved Myra's dilemma with unexploded bombs.

Postulational Style Competing styles of thinking influence research directions in business just as they do throughout the social and behavioral sciences. The *postulational*

style can be found in the upper portion of Exhibit 2–1. Studies in operations research and marketing are often postulational. For example, many firms run computer simulations of their market before a product rollout. These might examine different pricing levels or manufacturing output levels designed to optimize profitability. One goal of this perspective is to reduce the object of study to mathematical, formal terms. These terms, called *postulates,* are used to devise theorems that represent logical proofs. The objective is to deduce a mathematical model that may account for any phenomenon having similar form.

There is no single best perspective, only preferred perspectives, from which to view reality or do science. The range of available styles of thinking offers many frameworks to confront the diverse problems of business. Useful knowledge abounds; one should simply be aware of the vantage point selected to find information and the strengths and weaknesses of that position.

The Thought Process: Reasoning

Scientific inquiry has been described as a puzzle-solving activity.[7] For the researcher, puzzles are solvable problems that may be clarified or resolved through reasoning. In the opening scene of *The Sign of the Four,* Sir Arthur Conan Doyle uses a conversation between Sherlock Holmes and Dr. Watson to demonstrate the importance of precise reasoning and careful observation in the solving of puzzles and the unraveling of mysteries. Watson provides the test by handing Holmes a watch and asking him to venture an opinion on the character or habits of the late owner. Sherlock Holmes's fans are not disappointed in the outcome. After a few moments' examination, Holmes correctly infers the watch belonged to Watson's careless and untidy elder brother, a man who inherited wealth, treated his prospects foolishly, and died a drunkard. The speed of the conclusion is startling, but the trail of his reasoning process from small facts to inductions and on to conclusions, which he confirms with Watson, is a common thought process for detectives, scientists, and puzzle solvers.

Every day we reason with varying degrees of success and communicate our message, called meaning, in ordinary language or, in special cases, in symbolic, logical form. Our meanings are conveyed through one of two types of discourse: exposition or argument. *Exposition* consists of statements that describe without attempting to explain. *Argument* allows us to explain, interpret, defend, challenge, and explore meaning. Two types of argument of great importance to research are deduction and induction.

Deduction

Deduction is a form of inference that purports to be conclusive—the conclusion must necessarily follow from the reasons given. These reasons are said to *imply the conclusion* and *represent a proof.* This is a much stronger and different bond between reasons and conclusions than is found with induction. For a deduction to be correct, it must be both *true* and *valid:*

- Premises (reasons) given for the conclusion must agree with the real world (true).
- The conclusion must necessarily follow from the premises (valid).

A deduction is valid if it is impossible for the conclusion to be false if the premises are true. Logicians have established rules by which one can judge whether a deduction is valid. Conclusions are not logically justified if one or more premises are untrue or the argument form is invalid. A conclusion may still be a true statement, but for reasons other than those given. For example, consider the following simple deduction:

All regular employees can be trusted not to steal. (Premise 1)

John is a regular employee. (Premise 2)

John can be trusted not to steal. (Conclusion)

If we believe that John can be trusted, we might think this is a sound deduction. But this conclusion cannot be accepted as a sound deduction unless the argument form is valid and the premises are true. In this case, the form is valid, and premise 2 can be easily confirmed. However, many may challenge the sweeping premise that "All regular employees can be trusted not to steal." While we may believe John will not steal, such a conclusion is a sound deduction only if both premises are accepted as true. If one premise fails the acceptance test, then the conclusion is not a sound deduction. This is so even if we still have great confidence in John's honesty. Our conclusion, in this case, must be based on our confidence in John as an individual rather than on a general premise that all regular employees are honest.

As researchers, we may not recognize how much we use deduction to reason out the implications of various acts and conditions. For example, in planning a survey, we might reason as follows:

Inner-city household interviewing is especially difficult and expensive. (Premise 1)

This survey involves substantial inner-city household interviewing. (Premise 2)

The interviewing in this survey will be especially difficult and expensive. (Conclusion)

On reflection, it should be apparent that a conclusion that results from deduction is, in a sense, already "contained in" its premises.[8]

Induction

Inductive argument is radically different. There is no such strength of relationship between reasons and conclusions in **induction.** To induce is to draw a conclusion from one or more particular facts or pieces of evidence. The conclusion explains the facts, and the facts support the conclusion. To illustrate, suppose your firm spends $1 million on a regional promotional campaign and sales do not increase. This is a fact—sales did not increase during or after the promotional campaign. Under such circumstances, we ask, "Why didn't sales increase?"

One likely answer to this question is a conclusion that the promotional campaign was poorly executed. This conclusion is an induction because we know from experience that regional sales should go up during a promotional event. Also we know that if the promotion is poorly executed, sales will not increase. The nature of induction, however, is that the conclusion is only a hypothesis. It is one explanation, but there are others that fit the facts just as well. For example, each of the following hypotheses might explain why sales did not increase.

- Regional retailers did not have sufficient stock to fill customer requests during the promotional period.
- A strike by the employees of our trucking firm prevented stock from arriving in time for the promotion to be effective.
- A category-five hurricane closed all our retail locations in the region for the 10 days during the promotion.

In this example, we see the essential nature of inductive reasoning. The inductive conclusion is an inferential jump beyond the evidence presented—that is, although one

conclusion explains the fact of no sales increase, other conclusions also can explain the fact. It may even be that none of the conclusions we advanced correctly explain the failure of sales to increase. By using induction, Myra Wines wasn't convinced that the unexploded "dud" shells were harmless. While the army's conclusion was plausible, certainly at least one other conclusion was as valid before confirmation—that the unexploded shells experienced a delay and would explode upon further handling.

For another example, let's consider the situation of Tracy Nelson, a salesperson at the Square Box Company. Tracy has one of the poorest sales records in the company. Her unsatisfactory performance prompts us to ask the question, "Why is she performing so poorly?" From our knowledge of Tracy's sales practices, the nature of box selling, and the market, we might conclude (hypothesize) that her problem is that she makes too few sales calls per day to build a good sales record. Other hypotheses might also occur to us on the basis of available evidence. Among these hypotheses are the following:

- Tracy's territory does not have the market potential of other territories.
- Tracy's sales-generating skills are so poorly developed that she is not able to close sales effectively.
- Tracy does not have authority to lower prices and her territory has been the scene of intense price-cutting by competitive manufacturers, causing her to lose many sales to competitors.
- Some people just cannot sell boxes, and Tracy is one of those people.

Each of the above hypotheses is an induction we might base on the evidence of Tracy's poor sales record, plus some assumptions or beliefs we hold about her and the selling of boxes. All of them have some chance of being true, but we would probably have more confidence in some than in others. All require further confirmation before they gain our confidence. Confirmation comes with more evidence. The task of research is largely to (1) determine the nature of the evidence needed to confirm or reject hypotheses and (2) design methods by which to discover and measure this other evidence.

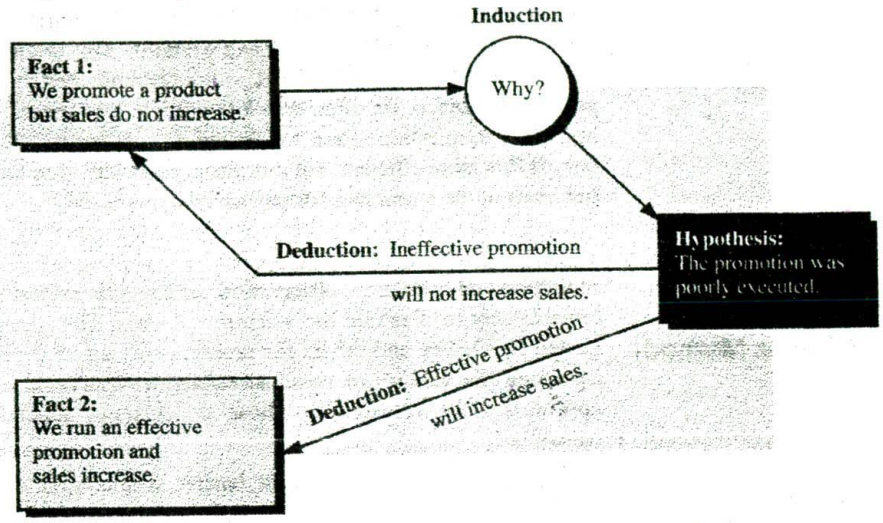
Combining Induction and Deduction

Induction and deduction are used in research reasoning in a sequential manner. John Dewey describes this process as the **double movement of reflective thought.**[9] Induction occurs when we observe a fact and ask, "Why is this?" In answer to this question, we advance a tentative explanation (hypothesis). The hypothesis is plausible if it explains the event or condition (fact) that prompted the question. Deduction is the process by which we test whether the hypothesis is capable of explaining the fact. The process is illustrated in Exhibit 2–2:

1. You promote a product but sales don't increase. ($Fact_1$)
2. You ask the question, "Why didn't sales increase?" (Induction)
3. You infer a conclusion (hypothesis) to answer the question: The promotion was poorly executed. (Hypothesis)
4. You use this hypothesis to conclude (deduce) that the sales will not increase during a poorly executed promotion. You know from experience that ineffective promotion will not increase sales. ($Deduction_1$)

This example, an exercise in circular reasoning, does point out that one must be able to deduce the initiating fact from the hypothesis advanced to explain that fact. A second critical point is also illustrated in this exhibit: To test a hypothesis, one must be able to deduce from it other facts that can then be investigated. This is what classical research

EXHIBIT 2–2 Why Didn't Sales Increase?

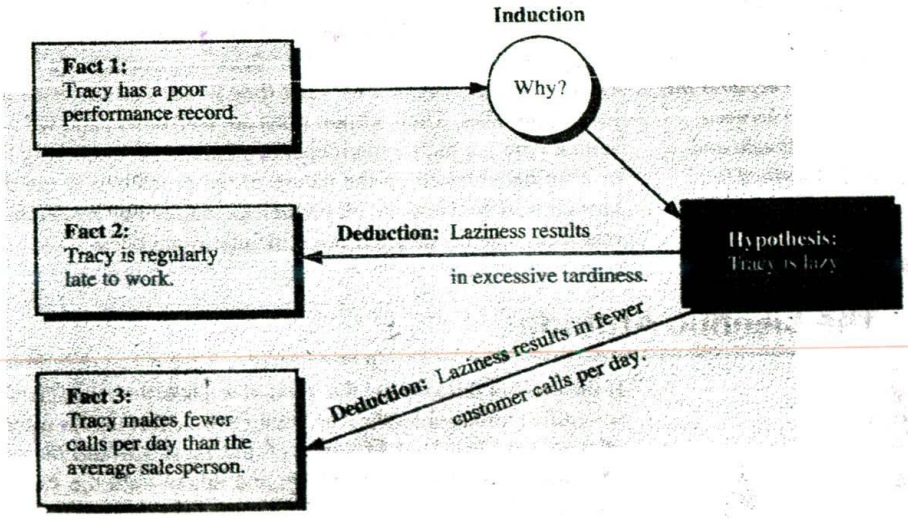


is all about. We must deduce other specific facts or events from the hypothesis and then gather information to see if the deductions are true. In this example, we deduce:

5. A well-executed promotion will result in increased sales. ($Deduction_2$)
6. We run an effective promotion and sales increase. ($Fact_2$)

How would the double movement of reflective thought work when applied to Tracy Nelson's problem? The process is illustrated in Exhibit 2–3. The initial observation ($fact_1$) leads to $hypothesis_1$ that Tracy is lazy. We deduce several other facts from the

EXHIBIT 2–3 Why Is Tracy Nelson's Performance So Poor?



hypothesis. These are shown as $fact_2$ and $fact_3$. We use research to find out if $fact_2$ and $fact_3$ are true. If they are found to be true, they confirm our hypothesis. If they are not, our hypothesis is not confirmed, and we must look for another explanation.

In most research, the process is more complicated than these simple examples suggest. For instance, we often develop multiple hypotheses by which to explain the phenomenon in question. Then we design a study to test all the hypotheses at once. Not only is this more efficient, but it is also a good way to reduce the attachment (and potential bias) of the researcher for any given hypothesis.

Reflective Thought and the Scientific Method

Induction and deduction, observation, and hypothesis testing can be combined in a systematic way to illustrate the scientific method. The ideas that follow, originally suggested by Dewey and others for problem-solving analysis, represent one approach to assessing the validity of conclusions about observable events. They are particularly appropriate for researchers whose conclusions depend on empirical data.[10] The researcher

1. Encounters a curiosity, doubt, barrier, suspicion, or obstacle.
2. Struggles to state the problem: Asks questions, contemplates existing knowledge, gathers facts, and moves from an emotional to an intellectual confrontation with the problem.
3. Proposes hypotheses to explain the facts that are believed to be logically related to the problem.
4. Deduces outcomes or consequences of the hypotheses: Attempts to discover what happens if the results are in the opposite direction of that predicted or if the results support the expectations.
5. Formulates several rival hypotheses.
6. Devises and conducts a crucial empirical test with various possible outcomes, each of which selectively excludes one or more hypotheses.
7. Draws a conclusion, an inductive inference, based on acceptance or rejection of the hypotheses.
8. Feeds information back into the original problem, modifying it according to the strength of the evidence.

We detail the research process that explores the relationship between reflective thought and scientific method in Chapter 3.

Eminent scientists who claim there is no such thing as the scientific method, or if it exists, it is not revealed by what they write, caution researchers about using template-like approaches. Their admonitions are well taken, and we would add that the ideas presented here are highly interdependent, are not sequentially fixed, and may be expanded or eliminated based on the nature of the problem and the perspective from which one has chosen to view it. Nevertheless, beginning researchers should understand that research, when conducted scientifically, is a process.

The Scientific Attitude

If the tools of thinking are the mind of science, then the scientific attitude is the spirit. The scientific attitude unleashes the creative drive that makes discovery possible. The portraits of scientists involved in some of the most spectacular discoveries of the twentieth century—Crick, Watson, Pauling, and others—are the stories of imagination, intuition,

curiosity, suspicion, anguish, the rage to know, and self-doubt. But these predispositions are not the exclusive province of the natural scientist. All researchers exercise imagination in the discovery process, in capturing the most essential aspect of the problem, or in selecting a technique that reveals a phenomenon in its most natural state.

Curiosity in its many forms characterized the persistent efforts to understand the relationship between productivity and worker satisfaction. Starting first with the Hawthorne studies, it was thought that employee satisfaction improved productivity.[11] Later research did not bear this out, and the second general conclusion was that satisfaction and productivity were not directly connected since the relationship was affected by a number of other variables. Currently, we believe that satisfaction is sought for reasons not consistently related to work, and productivity varies from simple to challenging tasks. Many contextual variables are now viewed as essential for understanding the original relationship.[12] Over 30 years elapsed while this research was being sorted out. The curiosity to ask questions compounded by the passion not to let go and a discomfort with existing answers sustained these researchers through periods of failure and self-doubt.

Thomas Kuhn, writing in *The Structure of Scientific Revolutions*, has also addressed the question of why scientists attack their problems with such passion and devotion. Scientific inquiry, he says, attracts people for a variety of motives. "Among them are the desire to be useful, the excitement of exploring new territory, the hope of finding order, and the drive to test established knowledge."[13] From applied researchers addressing a manager's need to academicians fascinated with the construction of grand theories, the attitude of science is the enabling spirit of discovery.

Understanding Theory: Components and Connections

Later in this chapter and in Part III we will use* variables *and* hypotheses *to make statements and propose tests for the relationships that our research questions express.

When we do research, we seek to know *what is* in order to understand, explain, and predict phenomena. We might want to answer the question, "What will be the employee reaction to the new flexible work schedule?" or "Why did the stock market price surge higher when all normal indicators suggested it would go down?" When dealing with such questions, we must agree on definitions. Which employees? What kind of reaction? What are the normal indicators? These questions require the use of concepts, constructs, and definitions. These components, or building blocks, of theory are reviewed in the next few sections.

Concepts

To understand and communicate information about objects and events, there must be a common ground on which to do it. Concepts serve this purpose. A **concept** is a generally accepted collection of meanings or characteristics associated with certain events, objects, conditions, situations, and behaviors. Classifying and categorizing objects or events that have common characteristics beyond any single observation create concepts. When you think of a spreadsheet or a warranty card, what comes to mind is not a single instance but collected memories of all spreadsheets and warranty cards abstracted to a set of specific and definable characteristics.

We abstract such meanings from reality and use words as labels to designate them. For example, we see a man passing and identify that he is running, walking, skipping, crawling, or hopping. These movements all represent concepts. We also have abstracted certain visual elements by which we identify that the moving object is an adult male, rather than an adult female or a truck or a horse. We use large numbers of concepts daily in our thinking, conversing, and other activities.

SNAPSHOT

ITE: Raising Questions about Danger

State Farm recently published its second list of the most dangerous intersections in the United States. The nation's largest auto insurer has been studying its proprietary accident claims data for detailed patterns since 1998. In that first year it discovered that one-third of all accidents involving State Farm–insured motorists took place in intersections. Prior studies in Michigan, Canada, and Australia indicated that low-cost changes could improve the safety of motorists in intersections—moving or improving signs or remounting traffic lights, improving light timing, and making lane markings more visible. For its study, State Farm analysts define an intersection as two roadways that intersect, excluding overpass crossings and interstate ramps. In the first study, a dangerous intersection was defined as one with the most auto crashes during the preceding year, with accident severity not a criterion. Estimated crashes were determined by weighting actual crash claims made to State Farm by a factor based upon the percentage of cars insured by State Farm in the metropolitan area where the intersection is located.

One organization, the Institute of Transportation Engineers (ITE), while complimenting the proactive stance of the auto insurer, has taken exception to the research methodology of State Farm in publishing its third annual list. In a press release, ITE has expressed its concern that "the State Farm Dangerous Intersection Initiative fails to adequately recognize ongoing efforts by the traffic engineering professionals in these jurisdictions." By selecting intersections based on its internal data of State Farm motorists and ignoring publicly available traffic volume and police accident data, ITE claims that State Farm's list is inaccurate. ITE further adds that engineers often do not have the budgets to implement the desired solutions even when they know a traffic hazard exists. How do the concepts and constructs measured here influence the intersections on the list? What is the nature of the conflicts here between researcher and information user?

www.ite.org

www.statefarm.com

Sources of Concepts Concepts that are in frequent and general use have been developed over time through shared usage. We have acquired them through personal experience. If we lived in another society, we would hold many of the same concepts (though in a different language). Some concepts, however, are unique to a particular culture and are not readily translated into another language.

Ordinary concepts make up the bulk of communication even in research, but we often run into difficulty trying to deal with an uncommon concept or a newly advanced idea. One way to handle this problem is to borrow from other languages (for example, *gestalt*) or to borrow from other fields (for example from art, *impressionism*). The concept of gravitation is borrowed from physics and used in marketing in an attempt to explain why people shop where they do. The concept of distance is used in attitude measurement to describe degree of variability between the attitudes of two or more persons. Threshold is used effectively to describe a concept in perception studies; velocity is a term borrowed by the economist from the physicist.

Borrowing is not always practical, so we sometimes need to adopt new meanings for words (make a word cover a different concept) or develop new labels (words) for concepts. The recent broadening of the meaning of *model* is an example of the first instance; the development of concepts such as sibling and status-stress are examples of the second. When we adopt new meanings or develop new labels, we begin to develop a specialized jargon or terminology. Researchers in medicine, the physical sciences, and related fields frequently use terms that are unintelligible to outsiders. Jargon no doubt contributes to efficiency of communication among specialists, but it excludes everyone else.

Importance to Research Concepts are basic to all thought and communication, yet in everyday use we pay little attention to the problems encountered in their use. In research, special problems grow out of the need for concept precision and inventiveness. We design hypotheses using concepts. We devise measurement concepts by which to test these hypothetical statements. We gather data using these measurement concepts. We may even invent new concepts to express ideas. The success of research hinges on (1) how clearly we conceptualize and (2) how well others understand the concepts we use. For example, when we survey people on the question of tax equity, the questions we use need to tap faithfully the attitudes of the respondents. Attitudes are abstract, yet we must attempt to measure them using carefully selected concepts.

The challenge is to develop concepts that others will clearly understand. We might, for example, ask respondents for an estimate of their family's total income. This may seem to be a simple, unambiguous concept, but we will receive varying and confusing answers unless we restrict or narrow the concept by specifying:

- Time period, such as weekly, monthly, or annually.
- Before or after income taxes.
- For head of family only or for all family members.
- For salary and wages only or also for dividends, interest, and capital gains.
- Income in kind, such as free rent, employee discounts, or food stamps.

Problems in Concept Use The use of concepts presents difficulties that are accentuated in a research setting. First, people differ in the meanings they include under any particular label. This problem is so great in normal human communication that we often see cases where people use the same language but do not understand each other. We might all agree to the meaning of such concepts as dog, table, electric light, money, employee, and wife. We may encounter more difficulties, however, when we communicate concepts such as household, retail transaction, dwelling unit, regular user, debit, and wash sale. Still more challenging are concepts that are familiar but not well understood, such as leadership, motivation, personality, social class, and fiscal policy. For example, personality has been defined in the research literature in more than 400 ways.[14] Although this may seem extreme, writers are not able to express the complexity of the determinants of personality and its attributes (e.g., authoritarianism, risk taking, locus of control, achievement orientation, and dogmatism) in a fashion that produces agreement.

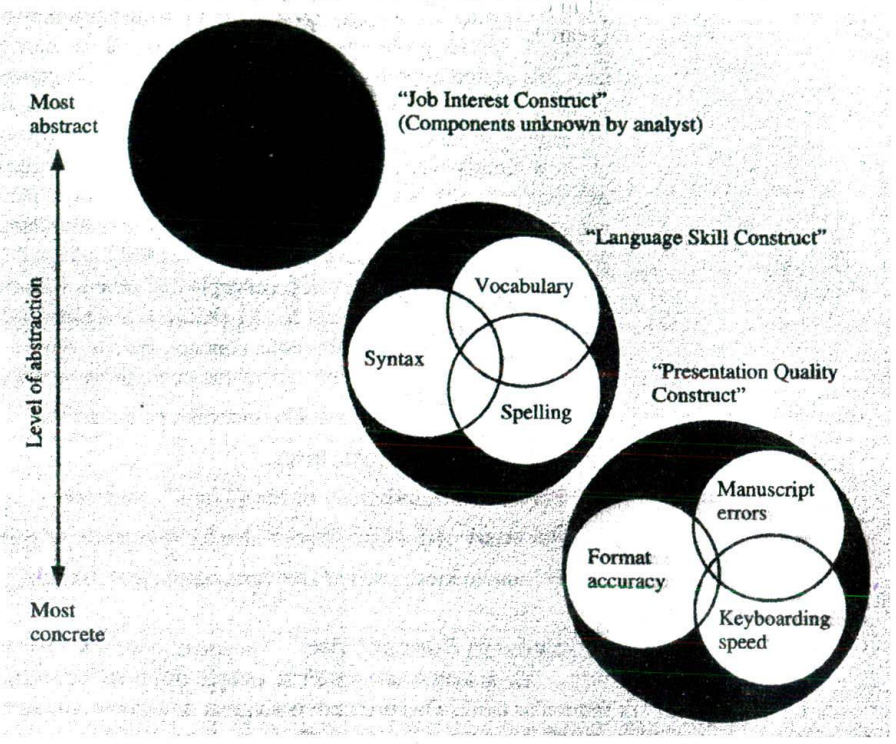
The concepts described represent progressive levels of abstraction—that is, the degree to which the concept does or does not have objective referents. Table is an objective concept in that we can point to tables and we can conjure up in our mind images of tables. An abstraction like personality is much more difficult to visualize. Such abstract concepts are often called constructs.

Constructs

As used in research in the social sciences, a **construct** is an image or idea specifically invented for a given research and/or theory-building purpose. We build constructs by combining the simpler concepts, especially when the idea or image we intend to convey is not directly subject to observation. When Jason and Myra tackle MindWriter's research study, they will struggle with the construct of a satisfied service customer.

Concepts and constructs are easily confused. Here's an example to clarify the differences involved. A human resource analyst at CadSoft, an architectural software company that employs technical writers for its product manuals, is analyzing task attributes of a

EXHIBIT 2–4 Constructs Composed of Concepts in a Job Redesign Example



job in need of redesign. She knows the job description for a technical writer consists of three components: presentation quality, language skill, and job interest. Her job analysis reveals more specific characteristics.

Exhibit 2–4 illustrates some of the concepts and constructs she is dealing with. The concepts at the bottom of the exhibit (format accuracy, manuscript errors, and keyboarding speed) are the most concrete and easily measured. We can observe keyboarding speed, for example, and even with crude measures agree on what constitutes slow and fast keyboarders. Keyboarding speed is one concept in the group that defines a construct that the human resource analyst calls "presentation quality." Presentation quality is a nonexistent entity, a "constructed type." It is used to communicate the combination of meanings presented by the three concepts. The analyst uses it as a label for the concepts she has found empirically to be related.

Concepts in the next level in Exhibit 2–4 are vocabulary, syntax, and spelling. The analyst also finds them to be related. They form a construct that she calls "language skill." She has chosen this term because these three concepts together define the language requirement in the job description. Language skill is placed at a higher level of abstraction in the exhibit because two of the concepts that comprise it, vocabulary and syntax, are more difficult to observe and their measures are more complex.

The analyst has not yet measured the last construct, "job interest." It is the least observable and most difficult to measure. It will likely be composed of numerous concepts—many of which will be quite abstract. Researchers sometimes refer to such entities as *hypothetical constructs* because they can be inferred only from the data; thus, they are presumed to exist but must await further testing. If research ultimately shows

the concepts and constructs in this example to be interrelated, and if the propositions that specify the connections can be supported, the researcher will have the beginning of a **conceptual scheme.** In graphic form it would depict the relationships among the knowledge and skill requirements necessary to clarify the job redesign effort.

Definitions

Confusion about the meaning of concepts can destroy a research study's value without the researcher or client even knowing it. If words have different meanings to the parties involved, then they are not communicating on the same wavelength. Definitions are one way to reduce this danger.

Researchers must struggle with two types of definitions: dictionary definitions and operational definitions. In the more familiar dictionary definition, a concept is defined with a synonym. For example, a customer is defined as a patron; a patron, in turn, is defined as a customer or client of an establishment; a client is defined as one who employs the services of any professional . . . , also, loosely, a patron of any shop.[15] These circular definitions may be adequate for general communication but not for research. In research, we must measure concepts and constructs, and this requires more rigorous definitions.

What operational definition did the army use for "dud" ordnance? What operational definition did Myra use?

Operational Definitions An **operational definition** is a definition stated in terms of specific testing or measurement criteria. These terms must have empirical referents (that is, we must be able to count, measure, or in some other way gather the information through our senses). Whether the object to be defined is physical (e.g., a machine tool) or highly abstract (e.g., achievement motivation), the definition must specify characteristics and how they are to be observed. The specifications and procedures must be so clear that any competent person using them would classify the objects in the same way.

During her military service, Myra observed numerous shells that, when fired, did not explode on impact. She knew the army applied the operational definition "a shell that does not explode on impact" to the construct *dud shell.* But if asked, Myra would have applied the operational term *dud shell* only to "a shell that, once fired from a

SNAPSHOT

Marriott: What Is Concierge Service?

Marriott International, Inc., is a leading hospitality company with more than 1,800 properties in 53 countries and territories under various brand names (Marriott, Fairfield Inn, Residence Inn, Courtyard, TownePlace Suites, Fairfield Suites, Renaissance, and ExecuStay). Due to its diverse operations, when managers in this company want to deliver global consistency, they turn to its sophisticated internal research division. "We wanted to know what level of service the terms *concierge, club,* or *executive* level implied. We also needed to know which term generated feelings of belonging and appreciation. We need a term that promises a level of superior service that we can deliver consistently in every property both in the United States and throughout the world," shared manager of marketing research Brenda Roth. The task then was to find a global term for the special services floor found in the Marriott and Renaissance properties. First "pulse groups" were conducted in the United States. Then a study was conducted involving 40 hotel intercept interviews in Hong Kong, London, and Frankfurt. Interviewers were bilingual, doing their interviews in the domestic language while recording responses in English to speed data processing and analysis. While most guests shared some common interpretations of the terms, "one possible German connotation of *concierge* was as a building superintendent similar to a custodian. Certainly not a desired interpretation." What operational definition would you develop for *concierge service?*

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cannon, could not be made to explode by any amount of manipulation, human or mechanical." Based on her operational definition, the town's residents rarely encountered "duds" during their excursions onto the firing range.

For another example, suppose college undergraduates are to be classified by class. No one has much trouble understanding such terms as *freshman, sophomore,* and so forth. But the task may not be that simple if you must determine which students fall in each class. To do this, you need operational definitions.

Operational definitions may vary, depending on your purpose and the way you choose to measure them. Here are two different situations requiring different definitions of the same concepts.

1. You conduct a survey among students and wish to classify their answers by their class levels. You merely ask them to report their class status, and you record it. In this case, class is freshman, sophomore, junior, or senior and you accept the answer each respondent gives as correct. This is a rather casual definition process but nonetheless an operational definition. It is probably adequate in this case even though some of the respondents report inaccurately.

2. You make a tabulation of the class level of students for the university registrar's annual report. The measurement task here is more critical, so your operational definition needs to be more precise. You decide to define class levels in terms of semester hours of credit completed by the end of the spring semester and recorded in each student's record in the registrar's office:

Freshman	Fewer than 30 hours' credit
Sophomore	30 to 59 hours' credit
Junior	60 to 89 hours' credit
Senior	More than 90 hours' credit

Those examples deal with relatively concrete concepts, but operational definitions are even more critical for treating abstract ideas. Suppose one tries to measure a construct called "organizational commitment." We may intuitively understand what this means, but to attempt to measure it among workers is difficult. We would probably develop a commitment scale, or we may use a scale that has already been developed and validated by someone else. This scale then operationally defines the construct.

While operational definitions are needed in research, they also present some problems. One ever-present danger is thinking that a concept and its operational definition are the same thing. We forget that our definitions provide only limited insight into what a concept or construct really is. In fact, the operational definition may be quite narrow and not at all similar to what someone else would use when researching the same topic. When measurements by two different definitions correlate well, the correlation supports the view that each definition adequately measures the same concept.

The problem of operational definitions is particularly difficult when dealing with constructs. Constructs have few empirical referents by which to confirm that an operational definition really measures what we hope it does. The correlation between two different definition formulations strengthens the belief that we are measuring the same thing. On the other hand, if there is little or no correlation, it may mean we are tapping several different partial meanings of a construct. It may also mean one or both of the operational definitions are not true labels.

Whether you use a definitional or operational definition, its purpose in research is basically the same—to provide an understanding and measurement of concepts. We

may need to provide operational definitions for only a few critical concepts, but these will almost always be the definitions used to develop the relationships found in hypotheses and theories.

Variables

Scientists operate at both theoretical and empirical levels. At the theoretical level, there is a preoccupation with identifying constructs and their relations to propositions and theory. At this level, constructs cannot, as we've said before, be observed. At the empirical level, where the propositions are converted to hypotheses and testing occurs, the scientist is likely to be dealing with variables. In practice, the term **variable** is used as a synonym for *construct* or the property being studied. In this context, a variable is a symbol to which we assign numerals or values.[16]

The numerical value assigned to a variable is based on the variable's properties. For example, some variables, said to be *dichotomous,* have only two values, reflecting the presence or absence of a property: employed-unemployed or male-female have two values, generally 0 and 1. When Myra Wines observed the cannon shells, they were exploded or unexploded. Variables also take on values representing added categories, such as the demographic variables of race or religion. All such variables that produce data that fit into categories are said to be *discrete,* since only certain values are possible. An automotive variable, for example, where "Chevrolet" is assigned a 5 and "Honda" is assigned a 6, provides no option for a 5.5.

Income, temperature, age, or a test score are examples of *continuous* variables. These variables may take on values within a given range or, in some cases, an infinite set. Your test score may range from 0 to 100, your age may be 23.5, and your present income could be $35,000.

Independent and Dependent Variables Researchers are most interested in relationships among variables. For example, does a participative leadership style (independent variable) influence job satisfaction or performance (dependent variables) or can a superior's modeling of ethical behavior influence the behavior of the subordinate? Exhibit 2–5 lists some terms that have become synonyms for **independent variable** and **dependent variable.** It is important to remember there are no preordained variables waiting to be discovered "out there" that are automatically assigned to one category or the other. As one writer notes:

> There's nothing very tricky about the notion of independence and dependence. But there is something tricky about the fact that the relationship of independence and dependence is

EXHIBIT 2–5 Defining Independent and Dependent Variables

Independent Variable	Dependent Variable
Presumed cause	Presumed effect
Stimulus	Response
Predicted from . . .	Predicted to . . .
Antecedent	Consequence
Manipulated	Measured outcome
Predictor	Criterion

a figment of the researcher's imagination until demonstrated convincingly. Researchers **hypothesize** relationships of independence and dependence: They invent them, and then they try by reality testing to see if the relationships actually work out that way.[17]

Moderating Variables In each relationship, there is at least one independent variable (IV) and a dependent variable (DV). It is normally hypothesized that in some way the IV "causes" the DV to occur. For simple relationships, all other variables are considered extraneous and are ignored. Myra sets out to discover why the locals are scavenging salvageable materials from the unexploded cannon shells. She hypothesizes:

> Locals' conviction that predetermined fate dictates time and place of death (IV) leads them to undertake life-threatening behaviors—scavenging on the firing range (DV).
>
> If locals could be warned of the danger (IV) of their actions, they would change their nocturnal behavior (DV).

The sheriff ultimately convinces Myra that only a change in army procedure will bring about the decline in shell-induced deaths caused by the nocturnal scavenging.

In a typical office, we might be interested in a study of the effect of the four-day workweek on office productivity and hypothesize the following:

> The introduction of the four-day workweek (IV) will lead to increased office productivity per worker-hour (DV).

In actual study situations, however, such a simple one-on-one relationship needs to be conditioned or revised to take other variables into account. Often one uses another type of explanatory variable of value here—the moderating variable (MV). A **moderating variable** is a second independent variable that is included because it is believed to have a significant contributory or contingent effect on the originally stated IV-DV relationship. For example, one might hypothesize that

> The introduction of the four-day workweek (IV) will lead to higher productivity (DV), especially among younger workers (MV).

In this case, there is a differential pattern of relationship between the four-day week and productivity that is the result of age differences among the workers.

Whether a given variable is treated as an independent or as a moderating variable depends on the hypothesis. If you were interested in studying the impact of length of workweek, you would make the length of week the IV. If you were focusing on the relationship of age of worker and productivity, you might use workweek length as a moderating variable. If Myra had been a reporter (rather than an army reserve captain) viewing the local death and injury statistics, she might have arrived at a different hypothesis:

> The loss of mining jobs (IV) leads to acceptance of higher-risk behaviors to earn a family-supporting income—race-car driving or nocturnal scavenging (DV)—especially due to the proximity of the firing range (MV) and the limited education (MV) of the residents.

Extraneous Variables An almost infinite number of **extraneous variables** (EV) exists that might conceivably affect a given relationship. Some can be treated as independent or moderating variables, but most must either be assumed or excluded from the study. Fortunately, the infinite number of variables has little or no effect on a given situation. Most can be safely ignored. Others may be important, but their impact occurs in such a random fashion as to have little effect.

Using the example of the effect of the four-day workweek, one would normally think the imposition of a local sales tax, the election of a new mayor, a three-day rainy

spell, and thousands of similar events and conditions would have little effect on workweek and office productivity.

However, there may be other extraneous variables to consider as possible confounding variables to our hypothesized IV-DV relationship. For example, Myra might think that level of education as it impacts job skills might have an impact on the selection of income-producing activity by the locals. This notion might lead to our introducing an extraneous variable as the **control:**

> Among residents with less than a high school education (EV-control), the loss of high-income mining jobs (IV) leads to acceptance of higher-risk behaviors to earn a family-supporting income—race-car driving or nocturnal scavenging (DV)—especially due to the proximity of the firing range (MV).

Alternatively, one might think that the *kind of work* being done would have an effect on any workweek length impact on office productivity. This might lead to our introducing a control as follows:

> In routine office work (EV-control), the introduction of a four-day workweek (IV) will lead to higher productivity (DV), especially among younger workers (MV).

In our office example, we would attempt to control for type of work by studying the effect of the four-day workweek within groups performing different types of work. In a similar way, Myra would attempt to control for employable job skills by studying the education patterns and prior employment of the scavengers who lost their lives.

Intervening Variables The variables mentioned with regard to causal relationships are concrete and clearly measurable; they can be seen, counted, or observed in some way. Sometimes, however, one may not be completely satisfied by the explanations they give. Thus, while we may recognize that a four-day workweek results in higher productivity, we might think this is not the full explanation—that workweek length affects some intervening variable, which, in turn, results in higher productivity. An intervening variable is a conceptual mechanism through which the IV and MV might affect the DV. The **intervening variable** (IVV) may be defined as "that factor which theoretically affects the observed phenomenon but cannot be seen, measured, or manipulated; its effect must be inferred from the effects of the independent and moderator variables on the observed phenomenon."[18]

In the case of the workweek hypothesis, one might view the intervening variable (IVV) to be job satisfaction, giving a hypothesis such as:

> The introduction of a four-day workweek (IV) will lead to higher productivity (DV) by increasing job satisfaction (IVV).

Here are additional examples illustrating the relationships involving independent, moderating, controlled extraneous, and dependent variables. The management of a bank wishes to study the effect of promotion on savings. It might advance the following hypothesis:

> A promotion campaign (IV) will increase savings activity (DV), especially when free prizes are offered (MV), but chiefly among smaller savers (EV-control). The results come from enhancing the motivation to save (IVV).

Or suppose you are studying a situation involving the causes of defective parts production. You might hypothesize the following:

> Changing to worker self-inspection (IV) will reduce the number of defective parts (DV) when the part can be identified with its producer (MV) in electronic assembly work (EV-control), by stimulating the worker's sense of responsibility (IVV).

And, finally, Myra's proposal to the army hypothesizes that

> Marking "dud" shells with kerosene lanterns for same-evening detonation (IV) will reduce nocturnal scavenging (DV) among poorly educated local residents (MV) by eliminating the profit motive for such behavior (IVV).

Propositions and Hypotheses

A checklist for developing strong hypotheses is presented in Exhibit 2–6.

We define a **proposition** as a statement about concepts that may be judged as true or false if it refers to observable phenomena. When a proposition is formulated for empirical testing, we call it a **hypothesis.** As a declarative statement, a hypothesis is of a tentative and conjectural nature.

Hypotheses have also been described as statements in which we assign variables to cases. A **case** is defined in this sense as the entity or thing the hypothesis talks about. The variable is the characteristic, trait, or attribute that, in the hypothesis, is imputed to the case.[19] For example, we might form the following hypothesis:

> Executive Jones (case) has a higher-than-average achievement motivation (variable).

If our hypothesis were based on more than one case, it would be a *generalization.* For example:

> Executives in Company Z (cases) have a higher-than-average achievement motivation (variable).

Descriptive Hypotheses Both of the above hypotheses are examples of **descriptive hypotheses.** These are propositions that typically state the existence, size, form, or distribution of some variable. For example:

- In Detroit (case), the October seasonally adjusted unemployment rate (variable) stands at 3.7 percent of the labor force.
- American cities (case) are experiencing budget difficulties (variable).

SNAPSHOT

AbioCor: A New Beat for Damaged Hearts

July 2, 2001, was a red-letter day in biomedical research when Abiomed—a developer, manufacturer, and marketer of medical products—had its AbioCor implantable replacement heart system surgically inserted in a 50-year-old man in Louisville, Kentucky. Thirty days later, the man was joking with nursing and medical staff, taking light exercise, and savoring a bite of cheesecake—even though most of his nutrition was still coming by way of a feeding tube. One member of the surgical team, Dr. Robert Dowling, said, "He was facing death 30 days ago and he knew it and now he is looking forward to life and is happy to be here." The AbioCor, which takes the space vacated by the removal of the patient's heart, is pumping seven liters of blood a minute compared with the two liters the patient's damaged heart could deliver. "Every parameter that we want to look at has gotten better," claimed Dowling. Dr. Laman Gray, Jr., also part of the research team, cautioned, "It is important to remember that this is the first chapter of many volumes that we have still to learn about the use of these devices in humans."

Following a series of animal trials, the FDA granted Abiomed permission to implant up to five AbioCor systems. With only 2,000 heart transplants performed each year, there are up to 100,000 coronary heart disease patients who might be potential recipients of the AbioCor, a device designed for those with less than a 30-day life expectancy who are not eligible for a heart transplant. Assuming government permission, should Abiomed rush into production of its AbioCor system? What reasoning approaches did you use to reach this conclusion? What concepts and constructs are imbedded in this example? What hypotheses could you form from this medical trial?

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- Eighty percent of Company Z stockholders (case) favor increasing the company's cash dividend (variable).
- Seventy percent of the high school–educated males (case) scavenge in the army firing range for salvageable metals (variable).

Researchers often use a research question rather than a descriptive hypothesis. Thus, in place of the above hypotheses, we might use the following questions:

- What is the unemployment rate in Detroit?
- Are American cities experiencing budget difficulties?
- Do stockholders of Company Z favor an increased cash dividend?
- Do a majority of high school–educated male residents scavenge in the army firing range for salvageable metals?

Either format is acceptable, but the descriptive hypothesis format has several advantages:

- It encourages researchers to crystallize their thinking about the likely relationships to be found.
- It further encourages them to think about the implications of a supported or rejected finding.
- It is useful for testing statistical significance.

Relational Hypotheses The research question format is less frequently used with a situation calling for **relational hypotheses.** These are statements that describe a relationship between two variables with respect to some case. For example, "Foreign (variable) cars are perceived by American consumers (case) to be of better quality (variable) than domestic cars." In this instance, the nature of the relationship between the two variables ("country of origin" and "perceived quality") is not specified. Is there only an implication that the variables occur in some predictable relationship, or is one variable somehow responsible for the other? The first interpretation (unspecified relationship) indicates a correlational relationship; the second (predictable relationship) indicates an explanatory, or causal, relationship.

Correlational hypotheses state merely that the variables occur together in some specified manner without implying that one causes the other. Such weak claims are often made when we believe there are more basic causal forces that affect both variables or when we have not developed enough evidence to claim a stronger linkage. Here are three sample correlational hypotheses:

- Young machinists (under 35 years of age) are less productive than those who are 35 years of age or older.
- The height of women's hemlines varies directly with the level of the business cycle.
- People in Atlanta give the president a more favorable rating than do people in St. Louis.

By labeling these as correlational hypotheses, we make no claim that one variable causes the other to change or take on different values. Other researchers, however, may view one or more of these hypotheses as reflecting cause-and-effect relationships.

With **explanatory (causal) hypotheses,** there is an implication that the existence of, or a change in, one variable causes or leads to a change in the other variable. As we noted previously, the causal variable is typically called the independent variable (IV) and the other the dependent variable (DV). *Cause* means roughly to "help make happen." So, the IV need not be the sole reason for the existence of, or change in, the DV. Here are four examples of explanatory hypotheses:

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- An increase in family income (IV) leads to an increase in the percentage of income saved (DV).
- Exposure to the company's messages concerning industry problems (IV) leads to more favorable attitudes (DV) by production workers toward the company.
- Loyalty to a particular grocery store (IV) increases the probability of purchasing the private brands (DV) sponsored by that store.
- An increase in the price of salvaged copper wire (IV) leads to an increase in scavenging (DV) on the army firing range.

In proposing or interpreting causal hypotheses, the researcher must consider the direction of influence. In many cases, the direction is obvious from the nature of the variables. Thus, one would assume that family income influences savings rate rather than the reverse case. This also holds true for the army example. Sometimes our ability to identify the direction of influence depends on the research design. In the worker attitude hypothesis, if the exposure to the message clearly precedes the attitude measurement, then the direction of exposure to attitude seems clear. If information about both exposure and attitude were collected at the same time, the researcher might be justified in saying that different attitudes led to selective message perception or nonperception. Store loyalty and purchasing of store brands appear to be interdependent. Loyalty to a store may increase the probability of buying the store's private brands, but satisfaction with the store's private brand may also lead to greater store loyalty.

The Role of the Hypothesis In research, a hypothesis serves several important functions:

- It guides the direction of the study.
- It identifies facts that are relevant and those that are not.
- It suggests which form of research design is likely to be most appropriate.
- It provides a framework for organizing the conclusions that result.

A frequent problem in research is the proliferation of interesting information. Unless the researcher curbs the urge to include additional elements, a study can be diluted by trivial concerns that do not answer the basic questions posed by the management dilemma. The virtue of the hypothesis is that, if taken seriously, it limits what shall be studied and what shall not.

To consider specifically the role of the hypothesis in determining the direction of the research, suppose we use this:

- Husbands and wives agree in their perceptions of their respective roles in purchase decisions.

The hypothesis specifies who shall be studied (married couples), in what context they shall be studied (their consumer decision making), and what shall be studied (their individual perceptions of their roles).

The nature of this hypothesis and the implications of the statement suggest that the best research design is a communication-based study, probably a survey or interview. We have at this time no other practical means to ascertain perceptions of people except to ask about them in one way or another. In addition, we are interested only in the roles that are assumed in the purchase or consumer decision-making situation. The study should not, therefore, involve itself in seeking information about other types of roles husbands and wives might play. Reflection upon this hypothesis might also reveal that husbands and wives disagree on their perceptions of roles but these differences may be explained in terms of additional variables, such as age, social class, background, personality differences, and other factors not associated with their difference in gender.

What Is a Good Hypothesis? A good hypothesis should fulfill three conditions:

- Adequacy for its purpose.
- Testable.
- Better than its rivals.

For a descriptive hypothesis, *adequacy for its purpose* means it clearly states the condition, size, or distribution of some variable in terms of values meaningful to the research task. If it is an explanatory hypothesis, it must explain the facts that gave rise to the need for explanation. Using the hypothesis, plus other known and accepted generalizations, one should be able to deduce the original problem condition.

A hypothesis is *testable* if it meets the following conditions.

- It does not require techniques that are unavailable with the present state of the research art.
- It does not require an explanation that defies known physical or psychological laws.
- There are consequences or derivatives that can be deduced for testing purposes.

Generally, a hypothesis is *better than its rivals* if it

- Has a greater range than its rivals.
- Explains more facts than its rivals.
- Explains a greater variety of facts than its rivals.
- Is simple, requiring few conditions or assumptions.

MANAGEMENT Tip

Three conditions for developing a strong hypothesis are summarized in Exhibit 2–6.

EXHIBIT 2–6 Checklist for Developing a Strong Hypothesis

Criteria	Interpretation
Adequacy for its purpose	❑ Does the hypothesis reveal the original problem condition?
	❑ Does the hypothesis clearly identify facts that are relevant and those that are not?
	❑ Does the hypothesis clearly state the condition, size, or distribution of some variable in terms of values meaningful to the research problem (descriptive)?
	❑ Does the hypothesis explain facts that gave rise to the need for explanation (explanatory)?
	❑ Does the hypothesis suggest which form of research design is likely to be most appropriate?
	❑ Does the hypothesis provide a framework for organizing the conclusions that result?
Testable	❑ Does the hypothesis use acceptable techniques?
	❑ Does the hypothesis require an explanation that is plausible given known physical or psychological laws?
	❑ Does the hypothesis reveal consequences or derivatives that can be deduced for testing purposes?
	❑ Is the hypothesis simple, requiring few conditions or assumptions?
Better than its rivals	❑ Does the hypothesis explain more facts than its rivals?
	❑ Does the hypothesis explain a greater variety or scope of facts than its rivals?
	❑ Is the hypothesis one that informed judges would accept as being the most likely?

Theory

Hypotheses play an important role in the development of theory. While theory development has not historically been an important aspect of business research, it is becoming more so.

A person not familiar with research uses the term *theory* to express the opposite of *fact*. In this sense, theory is viewed as being speculative or ivory tower. One hears that Professor X is too theoretical, that managers need to be less theoretical, or that some idea will not work because it is too theoretical. This is an incorrect picture of the relationship between fact and theory to the researcher.

When you are too theoretical, your basis of explanation or decision is not sufficiently attuned to specific empirical conditions. This may be so, but it does not prove that theory and fact are opposites. The truth is that fact and theory are each necessary for the other to be of value. Our ability to make rational decisions, as well as to develop scientific knowledge, is measured by the degree to which we combine fact and theory.

We all operate on the basis of theories we hold. In one sense, theories are the generalizations we make about variables and the relationships among them. We use these generalizations to make decisions and predict outcomes. For example, it is midday and you note that the outside natural light is dimming, dark clouds are moving rapidly in from the west, the breeze is freshening, and the air temperature is cooling. Would your understanding of the relationship among these variables (your weather theory) lead you to predict that something decidedly wet will probably occur in a short time?

Consider a situation where you interview two persons for possible promotion to the position of department manager. Do you have a theory about what characteristics such a person should have? Suppose you interview Ms. A and observe that she answers your questions well, openly, and apparently sincerely. She also expresses thoughtful ideas about how to improve departmental functioning and is articulate in stating her views. Ms. B, on the other hand, is guarded in her comments and reluctant to advance ideas for improvements. She answers questions by saying what "Mr. General Manager wants." She is also less articulate and seems less sincere than Ms. A. You would probably choose Ms. A, based on the way you combine the concepts, definitions, and propositions mentioned into a theory of managerial effectiveness. Your theory of managerial effectiveness, while workable, may not be a good theory because of the variables it has ignored, but it illustrates that we all use theory to guide our decisions, predictions, and explanations.

A **theory** is a set of systematically interrelated concepts, definitions, and propositions that are advanced to explain and predict phenomena (facts). In this sense, we have many theories and use them continually to explain or predict what goes on around us. To the degree that our theories are sound and fit the situation, we are successful in our explanations and predictions. Thus, while a given theory and a set of facts may not fit, they are not opposites. Our challenge is to build a better theory and to be more skillful in fitting theory and fact together.

While researchers note a difference, at times the terms theory and hypothesis are used synonymously. Doing so should not make much practical difference to your applied research.

How theory differs from hypothesis may also cause confusion. In this book, we make the general distinction that the difference between theory and hypothesis is one of *degree of complexity* and *abstraction*. In general, theories tend to be complex, abstract, and involve multiple variables. Hypotheses, on the other hand, tend to be simple, limited-variable propositions involving concrete instances.

Theory and Research It is important for researchers to recognize the pervasiveness and value of theory. Theory serves us in many useful ways:

- Theory narrows the range of facts we need to study.
- Theory suggests which research approaches are likely to yield the greatest meaning.

- Theory suggests a system for the researcher to impose on data in order to classify them in the most meaningful way.
- Theory summarizes what is known about an object of study and states the uniformities that lie beyond immediate observation.
- Theory can be used to predict further facts that should be found.

Models

The term *model* is used throughout the various fields of business and allied disciplines with little agreement as to its definition. This may be because of the numerous functions, structures, and types of models that exist. However, most definitions agree that models represent phenomena through the use of analogy. A **model** is defined here as a representation of a system that is constructed to study some aspect of that system or the system as a whole. Models differ from theories in that a theory's role is explanation whereas a model's role is representation:

> A model is not an explanation; it is only the structure and/or function of a second object or process. A model is the result of taking the structure or function of one object or process and using that as a model for the second. When the substance, either physical or conceptual, of the second object or process has been projected onto the first, a model has been constructed.[20]

Many ideas about new product adoption, for example, can be traced to rural sociology models. These models describe how information and innovations spread throughout communities or cultures by starting with opinion leaders. The behaviors of leaders are subsequently embraced by the greater society to express homage to the leader and retain social acceptance.

Models may be used for applied or highly theoretical purposes. Almost everyone is familiar with queuing models of services. Banks, post offices, telephone voice-response units, or airport security stations feed patrons to multiple stations starting from a single line. Other models for assembly lines, transportation, and inventory also attempt to solve immediate practical needs. A model to advance a theory of quality of work life, for example, could target employee behavior under conditions of flextime, permanent part-time, job-sharing, and compressed workweek.

Description, explication, and simulation are the three major functions of modeling. Each of these functions is appropriate for applied research or theory building.

Descriptive models	Describe the behavior of elements in a system where theory is inadequate or nonexistent.
Explicative models	Extend the application of well-developed theories or improve our understanding of their key concepts.
Simulation models	Clarify the structural relations of concepts and attempt to reveal the process relations among them.[21]
• **Static**	Represent a system at one point in time.
• **Dynamic**	Represent the evolution of a system over time.

Monte Carlo simulation models are examples of static simulations. They simulate probabilistic processes using random numbers. Redistribution of market share, brand switching, and prediction of future values are examples that benefit from dynamic modeling.

SUMMARY

1 Styles of thinking are perspectives or filters for determining how we view and understand reality. They affect what we accept as truth and specify how rigorously we test the information we receive before endorsing it. Although the scientific method is the preeminent means by which we secure empirical information, it is not the only source of truth. Other styles of thinking also have an apparent and often useful influence on business disciplines and place their imprimatur on the theory-building and problem-solving approaches of those fields.

Scientific inquiry is grounded in the inference process. This process is used for the development and testing of various propositions largely through the double movement of reflective thinking. Reflective thinking consists of sequencing induction and deduction in order to explain inductively (by hypothesis) a puzzling condition. In turn, the hypothesis is used in a deduction of further facts that can be sought to confirm or deny the truth of the hypothesis.

Researchers think of the doing of science (rather than the inspiration for discovery or the scientific attitude) as an orderly process that combines induction, deduction, observation, and hypothesis testing into a set of reflective thinking activities. Although the scientific method consists of neither sequential nor independent stages, the problem-solving process that it reveals provides insight into the way research is conducted.

2 Scientific methods and scientific thinking are based on concepts, the symbols we attach to bundles of meaning that we hold and share with others. We invent concepts to think about and communicate abstractions. We also use higher-level concepts—constructs—for specialized scientific explanatory purposes that are not directly observable. Concepts, constructs, and variables may be defined descriptively or operationally. Operational definitions, which are essential in research, must specify adequately the empirical information needed and how it will be collected. In addition, they must have the proper scope or fit for the research problem at hand.

Concepts and constructs are used at the theoretical levels; variables are used at the empirical level. Variables accept numerals or values for the purpose of testing and measurement. They may be classified as explanatory (independent, dependent, or moderating), extraneous, and intervening.

3 Propositions are of great interest in research because they may be used to assess the truth or falsity of relationships among observable phenomena. When we advance a proposition for testing, we are hypothesizing. A hypothesis describes the relationships between or among variables. A good hypothesis is one that can explain what it claims to explain, is testable, and has greater range, probability, and simplicity than its rivals.

Sets of interrelated concepts, definitions, and propositions that are advanced to explain and predict phenomena are called theories. Models differ from theories in that models are analogies or representations of some aspect of a system or of the system as a whole. Models are used for description, explication, and simulation.

KEY TERMS

case(s) 50
concept 41
conceptual scheme 45
construct 43
deduction 36
double movement of reflective thought 38
empiricism 33
hypothesis 50
  correlational 51
  descriptive 50
  explanatory (causal) 51
  relational 51
induction 37
model 55
operational definition 45
proposition 50
rationalism 33
theory 54
variable(s) 47
  control 49
  dependent 47
  extraneous 48
  independent 47
  intervening 49
  moderating 48

EXAMPLES

Company	Scenario	Page
Abiomed	Medical trial for the AbioCor implantable replacement heart system.	50
Army Reserve	Testing weaponry and ammunition.	BRTL, throughout
CadSoft*	Job description analysis for technical writers who document architectural software.	43
Institute of Traffic Engineers (ITE)	Contracting information on State Farm's Dangerous Intersection Initiative.	42
Marriott International, Inc.	An international hotel chain seeking an understanding of how hotel guests interpret the term *concierge service*.	45
State Farm Insurance	Data mining that revealed dangerous intersections.	42
York College*	A college alumni association studying opportunity in senior housing.	35

*Due to the confidential and proprietary nature of most research, the names of some companies have been changed.

DISCUSSION QUESTIONS

Terms in Review

1. Distinguish among the following sets of items, and suggest the significance of each in a research context.
   a. Concept and construct.
   b. Deduction and induction.
   c. Operational definition and dictionary definition.
   d. Concept and variable.
   e. Hypothesis and proposition.
   f. Theory and model.
   g. Scientific method and scientific attitude.
2. Describe the characteristics of the scientific method.

3. What are the differences among the research approaches (and thinking styles) that guide the predominant kinds of studies done in operations research, marketing, finance, and/or organizational behavior?

4. Here are some terms commonly found in a management setting. Are they concepts or constructs? Give two different operational definitions for each.

   a. First-line supervisor.

   b. Employee morale.

   c. Assembly line.

   d. Overdue account.

   e. Line management.

   f. Leadership.

   g. Price-earnings ratio.

   h. Union democracy.

   i. Ethical standards.

5. In your company's management development program, there was a heated discussion between some people who claimed, "Theory is impractical and thus no good," and others who claimed, "Good theory is the most practical approach to problems." What position would you take and why?

6. An automobile manufacturer observes the demand for its brand increasing as per capita income increases. Sales increases also follow low interest rates, which ease credit conditions. Buyer purchase behavior is seen to be dependent on age and gender. Other factors influencing sales appear to fluctuate almost randomly (competitor advertising, competitor dealer discounts, introductions of new competitive models).

   a. If sales and per capita income are positively related, classify all variables as dependent, independent, moderating, extraneous, or intervening.

   b. Comment on the utility of a model based on the hypothesis.

Making Research Decisions

7. You observe the following condition: "Our female sales representatives have lower customer defections than do our male sales representatives."

   a. Propose the concepts and constructs you might use to study this phenomenon.

   b. How might any of these concepts and/or constructs be related to explanatory hypotheses?

8. You are the office manager of a large firm. Your company prides itself on its high-quality customer service. Lately complaints have surfaced that an increased number of incoming calls are being misrouted or dropped. Yesterday, when passing by the main reception area, you noticed the receptionist fiddling with his hearing aid. In the process, a call came in and would have gone unanswered if not for your intervention. This particular receptionist had earned an unsatisfactory review three months earlier for tardiness. Your inclination is to urge this 20-year employee to retire or to fire him, if retirement is rejected, but you know the individual is well-liked and seen as a fixture in the company.

   a. Pose several hypotheses that might account for dropped or misrouted incoming calls.

   b. Using the double movement of reflective thought, show how you would test these hypotheses.

9. The Institute of Transportation Engineers, a nationwide trade association with thousands of members, was dissatisfied with the way that State Farm arrived at its Dangerous Intersection list.

   a. If ITE were to conduct a study of its own, what constructs and concepts would ITE define differently?

b. What hypotheses would ITE formulate to guide its version of the dangerous intersection study?

Bringing Research to Life

10. Identify and classify all the variables in the army's dud-shell research.

11. What was Myra's hypothesis for the army's dud-shell research? What was the army's hypothesis?

From Concept to Practice

12. Using Exhibits 2–2 and 2–3 as your guides, graph the inductions and deductions in the following statements. If there are gaps, supply what is needed to make them complete arguments.

a. Repeated studies indicate that economic conditions vary with—and lag 6 to 12 months behind—the changes in the national money supply. Therefore, we may conclude the money supply is the basic economic variable.

b. Research studies show that heavy smokers have a higher rate of lung cancer than do nonsmokers; therefore, heavy smoking causes lung cancer.

c. Show me a person who goes to church regularly, and I will show you a reliable worker.

WWW Exercises

Visit our website for Internet exercises related to this chapter at www.mhhe.com/business/cooper8

REFERENCE NOTES

1. The title of Exhibit 2–1 and the section "Styles of Thinking" is borrowed from Abraham Kaplan, *The Conduct of Inquiry* (San Francisco: Chandler, 1964), pp. 259–62. The axes and the positions of C. W. Churchman's inquiring systems are based on the work of I. I. Mitroff and R. O. Mason, "Business Policy and Metaphysics: Some Philosophical Considerations," *Academy of Management Review* 7 (1982), pp. 361–71. The locations of the other philosophical viewpoints in the exhibit are approximations.
2. P. McC. Miller and M. J. Wilson, eds., *A Dictionary of Social Sciences Methods* (New York: Wiley, 1983), p. 27. Also see Benjamin B. Wolman, ed., *Dictionary of Behavioral Science*, 2nd ed. (New York: Academic Press, 1989).
3. Kenneth R. Hoover, *The Elements of Social Scientific Thinking*, 5th ed. (New York: St. Martin's Press, 1991), p. 5.
4. Ronald Grover, "Gurus Who Failed Their Own Course," *Business Week*, November 8, 1999, p. 125.
5. Kaplan, *The Conduct of Inquiry*.
6. George S. Howard, *Methods in the Social Sciences* (Glenview, IL: Scott, Foresman, 1985), p. 7.
7. Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1970).
8. Howard Kahane, *Logic and Philosophy*, 2nd ed. (Belmont, CA: Wadsworth, 1973), p. 3.
9. John Dewey, *How We Think* (Boston: Heath, 1910), p. 79.
10. This section is based on Dewey, *How We Think*, and John R. Platt, "Strong Inference," *Science*, October 16, 1964, pp. 347–53.
11. F. J. Roethlisberger and W. J. Dickson, *Management and the Worker* (Cambridge, MA: Harvard University Press, 1939).
12. Paul R. Lawrence, "Historical Development of Organizational Behavior," in *Handbook of Organizational Behavior*, ed. Jay W. Lorsch (Englewood Cliffs, NJ: Prentice-Hall, 1987), p. 6.
13. Kuhn, *The Structure of Scientific Revolutions*, p. 37.
14. Hoover, *The Elements of Social Scientific Thinking*, p. 21.
15. *Merriam-Webster's Collegiate Dictionary*, 10th ed. (Springfield, MA: Merriam-Webster, 1999), http://www.m-w.com/cgi-bin/dictionary.
16. Fred N. Kerlinger and Howard B. Lee, *Foundations of Behavioral Research*, 4th ed. (New York: HBJ College & School Division, 1999).
17. Hoover, *The Elements of Social Scientific Thinking*, p. 71.
18. Bruce Tuckman, *Conducting Educational Research* (New York: Harcourt Brace Jovanovich, 1972), p. 45.
19. William N. Stephens, *Hypotheses and Evidence* (New York: Thomas Y. Crowell, 1968), p. 5.
20. Leonard C. Hawes, *Pragmatics of Analoguing: Theory and Model Construction in Communication* (Reading, MA: Addison-Wesley, 1975), p. 111.
21. Ibid., pp. 116–22.

REFERENCES FOR SNAPSHOTS AND CAPTIONS

ITE / State Farm

"CBS Evening News with Dan Rather," June 30, 1999.

"Dateline NBC," June 29, 1999.

"Dateline NBC," NBC News, July 1, 1999 (http://www.dateline.msnbc.com/news/284646.asp).

"Miami Area Intersection Tops State Farm List of Most Dangerous in the United States," State Farm press release, June 27, 2001.

"State Farm's Dangerous Intersection Initiative," Institute of Transportation Engineers press release, June 25, 2001 (http://www.ite.org/press_release.htm).

AbioCor

"Abiomed Provides Comments and Reaffirms AbioCor Clinical Trial Information Policies," Abiomed press release, July 13, 2001.

Lawrence K. Altman, "'Life Is Wonderful' for the Man with a Self-Contained Artificial Heart," *New York Times on the Web*, August 2, 2001 (http://www.nytimes.com/2001/08/02/healthy/anatomy/02hear.html).

Lawrence K. Altman, "Self-Contained Mechanical Heart Throbs for First Time in a Human," *New York Times on the Web*, July 3, 2001 (http://www.nytimes.com/learning/general/featured_articles/010705thursday.html).

"World's First AbioCor Implantable Replacement Heart Procedure Performed at Jewish Hospital by University of Louisville Surgeons," *ScienceDaily*, July 6, 2001 (http://www.sciencedaily.com/releases/2001/07/010706080839.htm).

Marriott

"About the Company," Marriott International, Inc. (http://www.marriott.com/corporateinfo/98annual/about.asp).

Brenda Roth, manager of research, Marriott International, Inc., Interview: January 2000, "Marriott History" (http://www.marriott.com/milestone.asp).

CLASSIC AND CONTEMPORARY READINGS

Beardsley, Monroe. *Practical Logic*. Englewood Cliffs, NJ: Prentice-Hall, 1969. A lucid discussion of deduction and induction as well as excellent coverage of argument analysis.

Browne, M. Neil, and Stuart M. Keeley. *Asking the Right Questions: A Guide to Critical Thinking*. Upper Saddle River, NJ: Prentice-Hall, 1997. Addresses question-asking skills and techniques necessary for evaluating different types of evidence.

Churchman, C. W. *The Design of Inquiring Systems*. New York: Basic Books, 1971. An essential work for understanding the connections between philosophy, science, and the nature of inquiry.

Hoover, Kenneth R., and Todd Donovan. *The Elements of Social Scientific Thinking*. 6th ed. New York: Worth Publishers, 1994. A brief but highly readable treatise on the elements of science and scientific thinking.

Kaplan, Abraham. *The Conduct of Inquiry*. San Francisco: Transaction Publications, 1998. A source for philosophy of science and logical reasoning.

Kerlinger, Fred N., and Howard B. Lee. *Foundations of Behavioral Research*. 4th ed. New York: HBJ College & School Division, 1999.